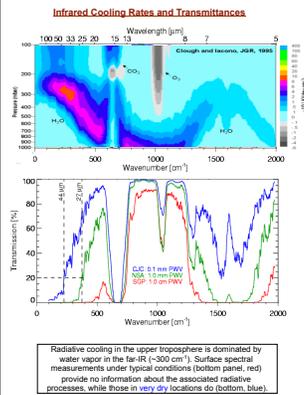


# Updated Water Vapor Retrievals and AERI Radiative Closure from the RHUBC-II Campaign

## The Radiative Heating in Underexplored Bands Campaign in Chile (RHUBC-II)



### Motivation:

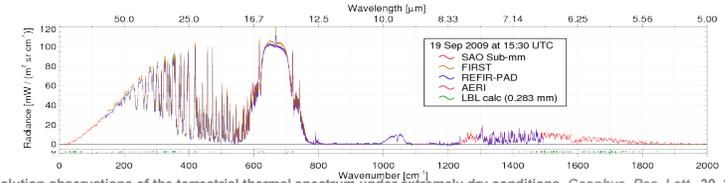
- Mid- and upper-tropospheric radiative cooling have important atmospheric effects
    - e.g. impacts vertical motions of the atmosphere
  - This radiative cooling occurs primarily in **water vapor** absorption bands that are opaque at the surface
  - Approximately 40% of the OLR comes from the far-IR
- Need to validate water vapor absorption models in these normally opaque bands.**
- To address this gap in our knowledge, we need:
- Spectrally resolved measurements in these bands
  - A very dry location so the bands are not opaque
  - Good characterization of the water vapor field above the spectral measurements

**Ultimate goal:**  
 Improved RT code (RRTM) in dynamical models



### RHUBC-II Campaign – ARM Program, July – November 2009

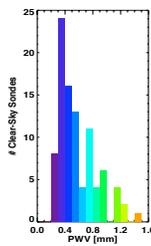
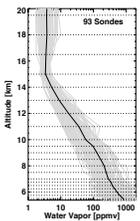
- Cerro Toco (5350 m), Atacama Desert, Chile -- extremely low water vapor
- Key Instruments
  - Vaisala **RS-92** radiosondes – 144 launches
  - G-band Vapor Radiometer Profiler (GVRP)** – 15 channels on side of 183.3 GHz WV line
  - SAO FTS** – zenith radiance from 300-3500 GHz (resolution 3 GHz)
  - NASA LaRC Far-IR Spectroscopy of the Troposphere (**FIRST**) – 100-1600 cm⁻¹ (res. 0.6 cm⁻¹)
  - CNR (Italy) Radiation Explorer in the Far-IR (**REFIR-PAD**) – 100-1400 cm⁻¹ (res. 0.5 cm⁻¹)
  - U. Wisc. Atmospheric Emitted Radiance Interferometer (**AERI**) – 550-3000 cm⁻¹ (res. 0.5 cm⁻¹)
  - Absolute Solar Transmittance Interferometer (**ASTI**) – 2000-10000 cm⁻¹ (res. 0.96 cm⁻¹)
- First ever measurement of entire terrestrial thermal spectrum



Turner and Mlawer, The Radiative Heating in Underexplored Bands Campaigns (RHUBC), *Bull. Amer. Met Soc.*, 91(7), 911-923, 2010; Turner et al., Ground-based high spectral resolution observations of the terrestrial thermal spectrum under extremely dry conditions, *Geophys. Res. Lett.*, 39, 2012.

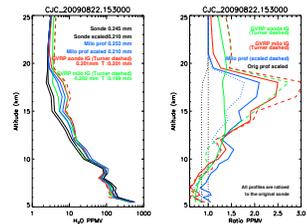
## Best Estimate Water Vapor Profiles – Implications of Updates to Microwave RT Code

### Sonde Measurements During RHUBC-II



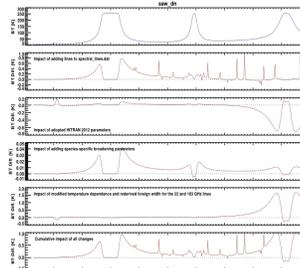
Water vapor column amounts (PWV) measured by radiosondes during RHUBC-II. (The PWV for US Standard atmosphere is 14.3 mm.)

### Improve H<sub>2</sub>O Profiles Retrieved Using GVRP Measurements on the 183.3 GHz H<sub>2</sub>O Line

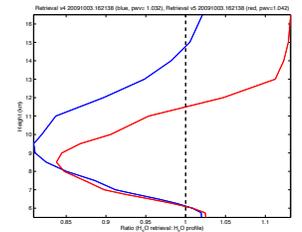


Calculated brightness temperatures and GVRP channel centers

The water vapor profile retrieval uses the radiation code MonoRTM, which recently had a major revision (v5.0) with updated spectroscopy.



Impact of revised code on downwelling radiances near 183 GHz is not negligible.



Water vapor profile retrieved with **revised code** has a somewhat different shape than **previous retrieval**, as well as a slightly different PWV. These profile differences result in different calculated infrared radiances.

As a result, all retrievals (~3200) are being rerun.